CHAPTER 4

SPEED CONTROLLING DEVICES

In the EN3 TRAMAN, you learned some basic information about the methods and the devices that control the output of the injection pumps and injectors. The purpose of these devices is to ensure control of engine operation.

This chapter contains general information about maintenance and repair of speed controlling devices known as governors. You should refer to the appropriate manufacturer's technical manuals and the maintenance requirements (3-M) for more specific information. *Woodward Diesel Engine Speed Governors Operation and Maintenance Manual,* NAVSHIPS 341-5017, *Marquette Governor Maintenance Manual,* NAVSHIPS 341-5505, and *Naval Ships' Technical Manual,* Chapter 233, "Diesel Engines," are good sources of information.

GOVERNORS

To control an engine means to keep it running at a desired speed, either with, or regardless of, the changes in the load carried by the engine. The degree of control required depends on the following factors:

- The engine's performance characteristics
- The type of load it drives

In diesel engines, the speed and power output is determined by varying the amount of fuel injected into the cylinders to control combustion. Hydraulic and mechanical are the two principal types of governors.

HYDRAULIC GOVERNORS

This chapter will deal only with the most common troubles that may be encountered with hydraulic governors. Poor regulation of speed may be due to the faulty adjustment of the governor or to the faulty action of an engine. Or it could be a problem with a synchronizing motor, a voltage regulator, or any piece of equipment that has a direct bearing on the operation of the engine.

Manufacturers stated that 50 percent of all governor troubles are caused by dirty oil. For this reason, you should take every precaution to prevent the oil from becoming contaminated. Most hydraulic governors use the same type of oil that is used in the engine crankcase, provided it is absolutely clean and does not foam. You should change the oil in the governor at regular intervals, depending upon the type of operation. But regardless of the operation or the preventive maintenance schedule, it must be changed at least every 6 months. You must make sure the oil containers used to fill the governors are clean and that only clean, new, or filtered oil is used. You should also check the oil level frequently to make sure the proper level is maintained and the oil does not foam. Foaming oil is usually an indication that water is present in the oil. Water in the oil will cause serious damage to the governor.

When a new or overhauled governor is installed, you should adjust the governor compensating needle valve (even though it has been adjusted previously at the factory or repair facility). This adjustment is made with the governor controlling an engine with a load. If this adjustment is not made, high overspeeds and low underspeeds after load changes will result and the return to normal speeds will be slowed. Follow the procedure listed in the manufacturer's maintenance manual and the PMS.

When a governor problem is suspected, before performing any maintenance or adjustments, disconnect the governor fuel rod end from the fuel control rack and make sure there is no binding or sticking of the fuel control rack. This procedure will determine if the trouble is actually the governor.

The chart in table 4-1 lists some of the probable causes of problems that are common to most hydraulic governors. This chart is for your general information, and it should not be used as a guide to troubleshoot a governor. You should use the applicable manufacturer's instruction manual for troubleshooting.

The following are the definitions of some terms used in the chart:

HUNTS: Rhythmic variations of speed that can be eliminated by blocking the fuel linkage manually. They will reappear when returned to governor control.

SURGES: Rhythmic variations of speed of large magnitude that can be eliminated by blocking the fuel linkage manually. They will not reappear when returned

Table 4-1.—Governor Probable Causes and Corrective Actions Chart

Problem	Probable Cause	Corrective Action
Engine hunts or surges	Compensating needle valve adjustment incorrect	Make needle valve adjustment; ensure that the opposite needle valve is closed
	Dirty oil in governor	Drain oil; flush governor; refill
	Low oil level	Fill to correct level with clean oil
	Foamy oil in governor	Drain oil; refill
	Lost motion in engine governor linkage or fuel pumps	Repair linkage and realign pumps
	Governor worn or incorrectly adjusted	Remove governor and make internal checks for clearances according to applicable instructions
	Engine misfiring	Test and replace injectors
	External fuel linkage sticking or binding	Disconnect fuel rack from governor and manually move linkage and progressively disconnect fuel pump links until binding area is found (dirt, paint, and misalignment are the usual causes of binding)
Governor rod end jiggles	Rough engine drive	Check alignment of gears; inspect for rough gear teeth; check backlash of gear
	Governor base not bolted down evenly	Loosen bolts; realign and secure

to governor control unless the speed adjustment of the load changes.

JIGGLES: High-frequency vibrations of the governor fuel rod end or engine fuel linkage. Do not confuse jiggle with the normal regulating action of the governor.

When normal governor adjustments do not give the desired response, the hydraulic governor should be removed and you should send it to a repair activity for cleaning, overhaul, and recalibration. You should have a spare governor so that the engine can be operated during the governor overhaul period and other PMS that require removal of the original governor.

MECHANICAL GOVERNORS

The Navy generally uses the spring-loaded flyball-type mechanical governors. All flyball-type mechanical governors have speed droop. This means, as the load is increased at a constant throttle setting, the speed of the engine will drop or droop slightly, rather than remain constant. Consequently, mechanical governors of this type are never used where absolute constant speeds are necessary.

Besides the spring-loaded flyball-type governors, there are several other types of mechanical governors. The two most common types are used on GM 71 engines. One type, the constant-speed governor, is used on generator sets and is designed to hold the speed of the engine at a predetermined operating speed. The other type, similar in construction, is used primarily for propulsion engines. It has a throttle plate designed so that intermediate speeds may be obtained by manual adjustment. Notice that there is no buffer spring adjustment on the constant-speed governor. The following description applies to both types of governors.

In the idling speed range, control is effected by centrifugal force on the two sets of large and small flyweights, as shown in figure 4-1. This flyweight force acts against a light (low-speed) spring. Maximum speed

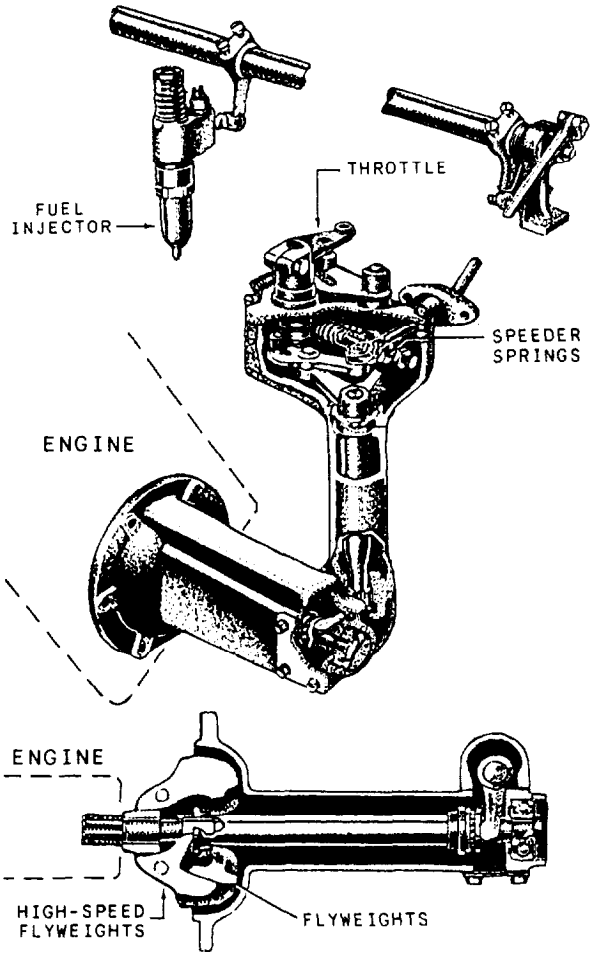

Figure 4-1.—GM mechanical governor.

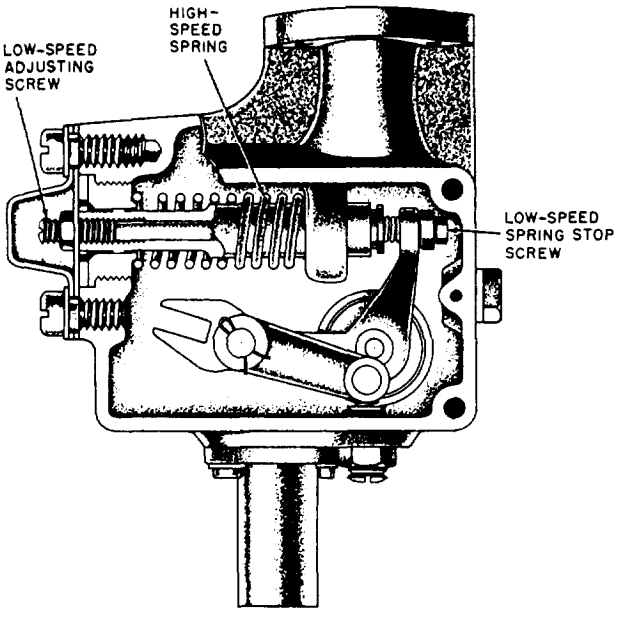

Figure 4-2.—Mechanical governor control mechanism.

control is effected by the action of the high-speed (small) flyweights acting against a heavy (high-speed) spring. See figure 4-2. If you have any questions or need more illustrations to understand the concept of governor operations, refer to chapter *9* of *Engineman 3*, NAVEDTRA 10539.

Mechanical governor faults are usually revealed in speed variations. But not all speed variations are faults of the governor. When abnormal speed variations appear, you should first do the following procedures:

1. Check the load to be sure the speed changes are not the result of load fluctuations.

2. If the load is steady, check the engine to make sure all the cylinders are firing properly.

3. Make sure there is no binding in the governor mechanism or operating linkage between the governor and the engine. There should be no binding in the injector control rack shaft or its mounting brackets. If you find no binding anywhere and the governor still fails to control the engine properly, you may assume that the governor is worn or inoperative.

If the governor is the cause of improper speed variations, it must be completely disassembled, inspected, and rebuilt or replaced. When it is necessary to disassemble and reassemble the governor, you should secure a copy of the manufacturer's instruction book and follow the instructions given. During reassembly of the governor, use only hard grease on the gasket! Under NO circumstances should you use shellac on the gasket. Adjustment procedures for the replacement of any governor are listed in the manufacturer's instruction manual and should be followed with particular attention given to the precautions listed.

OVERSPEED SAFETY DEVICES

Mechanical overspeed trips depend upon the centrifugal forces developed by the engine and must be maintained in good working condition. A faulty overspeed device can endanger not only the engine but also the personnel. The engine could explode or fly apart because of the uncontrolled speed.

The engine instruction manual contains information as to the speed at which the overspeed device is designed to function. Most overspeed trips are adjustable. Before making any changes in the adjustment of the overspeed trip, you must determine the cause. If the engine did not trip out, was it for some reason other than the action of the element of the overspeed trip? You should first check the accuracy of the tachometer and then test the

overspeed trip. Remember that all spring tension and linkage adjustments to an overspeed are critical. Instructions for these adjustments are found in the manufacturer's instruction manual. You MUST follow these instructions!

Hydraulic overspeedtrips are extremely sensitive to dirt. Dirt or lacquer like deposits may cause the trip to bind internally. The speed-sensitive element and all parts of the linkage and mechanisms incorporated with the speed-sensitive element must be kept clean. When painting around the engine, you must avoid allowing paint to fall on joints, springs, pins, or other critical points in the linkage.

The overspeed trip will not function properly if parts arc bent, badly worn, improperly installed, or dirty, or if their motion is restricted by some other part of the engine. In some situations the driveshaft of the overspeed trip may be broken; this would prevent rotation of the flyweight and the overspeed trip. Insufficient oil in the hydraulic trip may be another source of trouble. You should maintain a proper oil level as specified by the instruction manual.

The following are some general procedures you should follow to keep the overspeed safety devices in proper operation:

– Keep the overspeed trip and its linkage clean.

– Remove the source of binding.

– Replace faulty parts.

– Maintain a proper oil level in the hydraulic overspeed trip.

– Adjust the speed-sensitive element according to the instruction manual.

– If the trip has been damaged, replace it with a spare and completely rebuild or overhaul the damaged one according to the instruction manual.

Test overspeed trips and governor mechanisms once each quarter and after each major engine overhaul. To verify if the safety device is in proper working order, overspeed the engine. When you are making this test, use a tachometer to check the speed at which the overspeed mechanism will operate. These safety devices should operate at the speed specified in the engine instruction manual. If this information is not available, the following values should be used for the test:

- For large, slow-speed engines, the value is 107 percent maximum-rated speed.

- For high-speed engines, the value is 110 percent maximum-rated speed.

If there is any irregularity during testing, stop the test and check the overspeed safety device and correct the problem before continuing the test procedure.

SUMMARY

This chapter has presented several common facts in maintenance, repair, and overhaul of speed controlling devices. Maintenance personnel must secure the appropriate manufacturer's instruction manual. No repair, maintenance, or overhaul of these precision pieces of equipment should be made until the appropriate manual is obtained. You must read, understand, and strictly follow the instructions from the manufacturer. Be sure to pay particular attention to any safety precautions given in these instructions.